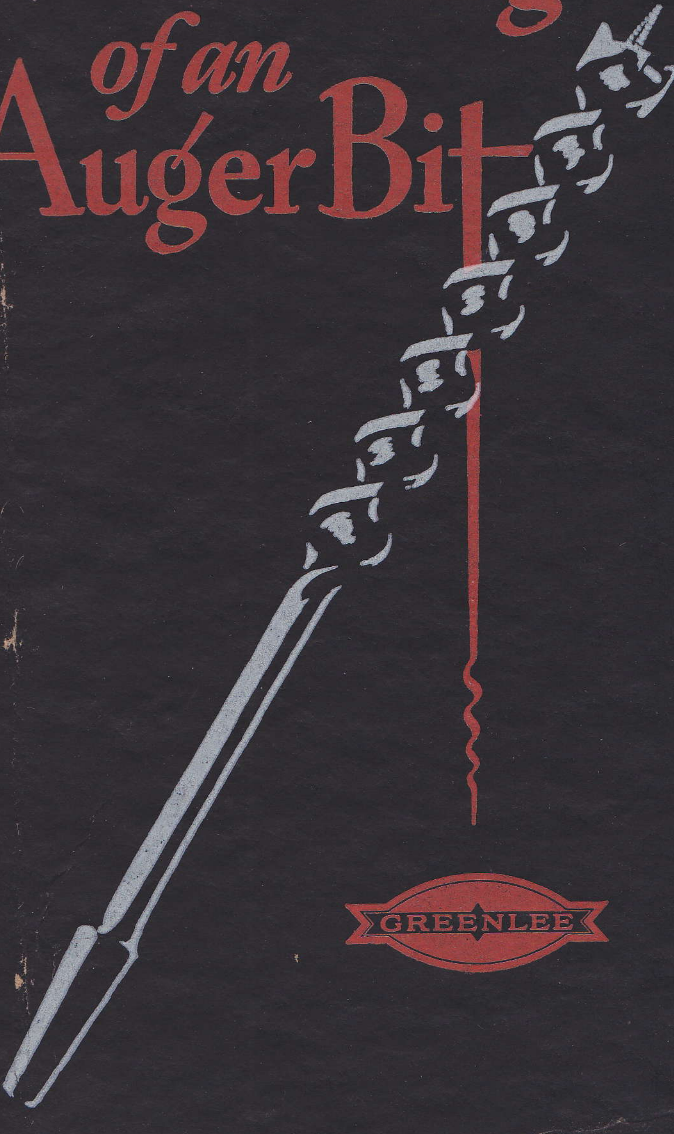
The Making of an Auger Bit



GREENLEE

The Making of an Auger Bit

An illustrated talk on how Auger Bits are made.

1928

GREENLEE TOOL CO.
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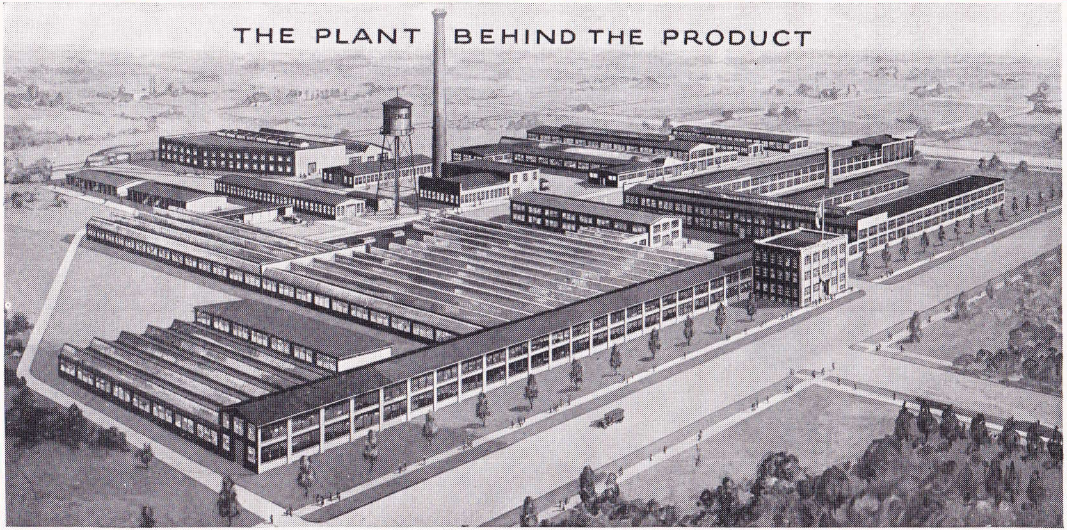


Where Greenlee Auger Bits are made

Foreword

THERE is a wonderful fascination in all merchandise for those who truly know it.

The man who makes silk knows its composition from the silk worm up; the man who fashions an earthenware jug knows the process from the red clay in the pit to the trademark on the finished product.

To know is to understand. And the reason things are uninteresting is because we do not know the processes through which they have arrived.

Probably because of its apparently simple design and operation the auger bit to most of us is just one of those everyday affairs which we take merely for granted. There are very few who know that in the manufacture of a bit there are about 45 distinct operations, many of which are just the opposite to the standard practice of machining fundamentals. On account of these peculiarities the making of an auger bit is a highly specialized process and to come to know this is a fascinating revelation.

Therefore, the purpose of this booklet is plain—we want you to know our product, and the plant behind it, which in any instance establishes that product's standard.

Externally, bits may look very much alike. To most customers the trademark alone distinguishes them. Internally, there may be a wide difference in quality.

But quality in bits covers a multitude of points. Quality suffers abuse but endures. Two pairs of shoes may appear the same except in price, yet the higher priced pair will usually give more wear for the dollar.

The reason for the difference in bits or shoes is the standard of the shop behind the brand.

The standard of the Greenlee shops makes the quality of their product. A little higher grade of steel, a more careful

workmanship on every operation and a final searching inspection explains the result.

Any one can claim quality. The tests of accuracy, finish, wear, and uniformity determine it. But these follow only when the standard of the shop and the men in the shop is quality.

Our standard of quality is evidenced quite as much in our system of wage payment and inspection, in the character of our buildings and their mechanical equipment as in the grades of our steel and our workmanship. Good soil is necessary for good crops.

It takes character to produce character. The character of his surroundings influences that of the workman; and character in the workman insures quality in his product.

Now we will take a little journey to observe where Greenlee bits are made and how.

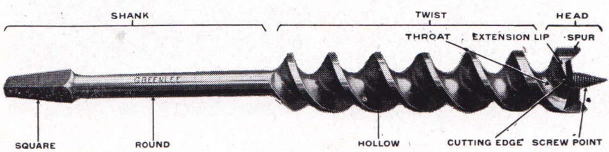
The Forging

SINCE there are two distinct divisions in the manufacture of an auger bit, this story will be divided into two parts—"The Forging" and "The Finishing." The forging is our first chapter because it deals with the shaping from a crude piece of steel to practically a completely formed auger bit. Our last chapter will cover the finishing of our bit, that is, machining, polishing, and fitting it ready for use. This also includes inspection and packing.

The small cut shown here is introduced for the purpose of getting acquainted with the various parts of our product. We will go over the different names together and in that way you will obtain a fair working knowledge of the different parts. This will make it easier to understand each step as we advance.

Generally speaking there are three parts to a bit, namely: the head, the twist, and the shank. But these in turn have their different parts.

The head consists of two spurs, two cutting edges and two extension lips; also a screw point which pulls the bit into the wood. The spurs outline the hole and sever the fibres in advance of the cutting edges. These cutters, or more favorably known as chip lifters, cut the chips and lift them into the



The Parts of an Auger Bit

throat which starts them on their upward journey. The extension lip is that portion of the chip lifter between the cutting edge and the base of the spur. It is from the extension lips that this type of bit gets its name, Extension Lip Auger Bit.

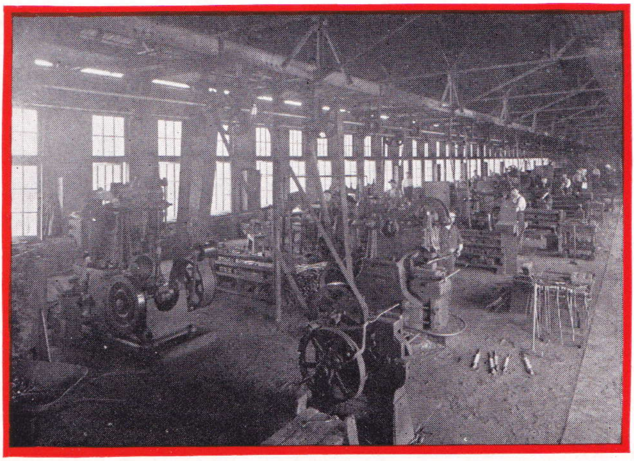
The twist is that portion between the head and the shank, the hollows of which carry off the chips as they leave the throat. The hollows must be large and uniform so that the chips will not clog in passage, and the circumference of the edge of the twist must be smaller than the circumference of the head so that the bit will not bind in boring.

The square is the part that fits into the brace. The square and the round make up the shank, which term is most commonly used.

Now we are ready for our journey. First you see a long fire proofed building with high, close set windows, each of them open wide. Above are steel framed sash and on the roof a long steel ventilator. This is our forge shop.

In the interior view on the next page you see machines and forge fires down the center. The workmen stand along

The Forge Shop



Interior View of Forge Shop

broad aisles at either side. The cool breezes sweep in around them, the hot gases are drawn away at the roof. They work in comfort.

Down at the receiving end of the building, the steel enters from racks of the stock shed. This raw material is purchased in carload lots and carried in ample quantities to meet all demands of our trade.

The steel is in rounds, squares and flats. The rounds are used in drills, ship augers, solid center and small auger bits. The flats in large bits and double twist augers. The bit which we are discussing is of the last mentioned type. This steel is made to our specifications and rolled in exact sizes needed. There is no better steel for the purpose than that used in Greenlee bits.

You should know that we make more than ninety distinct types of boring tools. Of some types we carry in stock as

A Machine Bit

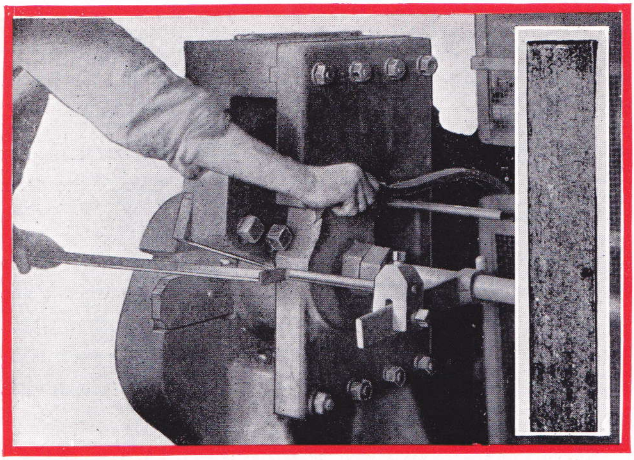
many as thirty-two sizes. In machine bits, which are used in boring machinery, the various patterns are made in diameters from $\frac{3}{16}$-inch to 6 inches, and in lengths from one inch to six feet.

Each size and type of tool regularly made must have its own set of dies for the hammering, twisting, heading and straightening operations. The capital invested in forging dies alone runs into very large figures.

In some tools the shank must be larger than the twist, while in most tools the reverse is true. Some tools must have a very heavy twist or extra large cutters and screw point. All of these variations must also be considered in selecting our stock sizes of steel.

These facts may give you an idea of the infinite variety of bits that must be made in one shop, and the complexity of the die equipment as well as the stock of material for making them.

One Section of Steel Stock Shed



Shearing

You first see an operator pick up a bar of steel and place it between the jaws of a powerful shear. He sets a stop gauge the length of the pieces and then clips them off as if cutting paper.

The pieces of steel as they are cut go into trays. These trays are open-sided steel boxes used both for handling and checking the bits as they go through the forge shop. They are easily handled and can be stacked up. You will see hundreds of them with tools in all stages. A tray may contain five hundred pieces for one quarter-inch bits or one hundred twenty-five for the one-inch size.

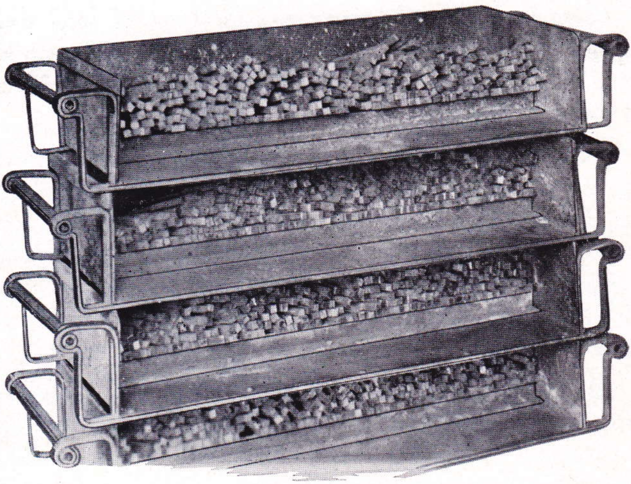
These trays are the key to our checking and inspecting system. A record is kept of each man as he performs his work on the pieces in any tray. As the tray moves from one operation to another, any imperfect work can be traced back to the man who caused it.

The first operation under the hammer is forming the "round" and "square" or that part of an auger bit which fits into the brace chuck. The cut on the following page shows this quite clearly.

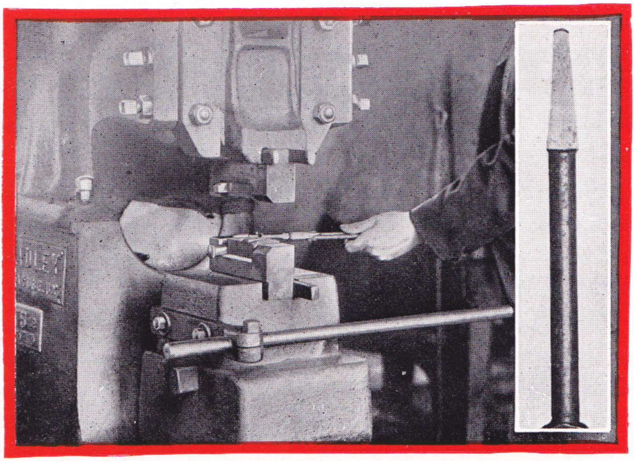
Each operator has an oil furnace and a power hammer. In the one he heats the steel, and under the dies in the other he shapes it.

Perhaps you have not seen a power hammer in action. Its hammer arm is raised by power and allowed to strike with whatever force and speed the operator requires. These hammers are of various sizes. Some have the power of forty blacksmiths' arms and some represent about three hundred arm-power at a single stroke.

The operator with a pair of tongs picks a hot steel blank out of the furnace and places it under the hammer. He



Handling Trays



Forming the Square

presses the foot lever firmly and forges with rapid heavy strokes. He eases the pressure on the treadle and finishes his piece with a few light taps. Almost instantly the appearance of the piece has changed as you see it, and it is placed in a tray ready for the next operation.

We shall picture the piece under the hammer or in the machine as each operation is performed, and in the small insert view the result as we follow our bit.

Next comes the forming of the "plate." After again heating it in the hot blast of the oil furnace, the bit goes under the fast working hammer where it is drawn into a convex section or plate for the greater part of its length. It is left with a short end section in its original size which is used in forming the head. This operation is called "plating" a double twist bit. The piece is worked rapidly but accurately as to size.

From the forge shop standpoint, in making bits there are two general classes. The distinguishing feature is whether the

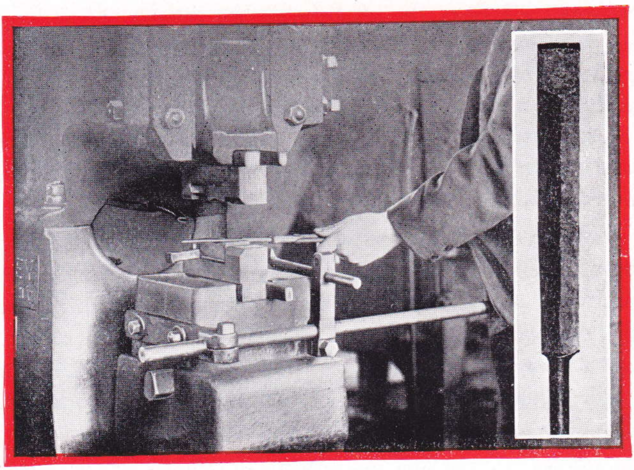
twist is forged in a die directly under the hammer or first drawn down to a plate and then twisted.

Our single twist tools, ship augers and solid center bits are forged directly into the twist or spiral by means of special dies. As we call it, they are worked under the hammer.

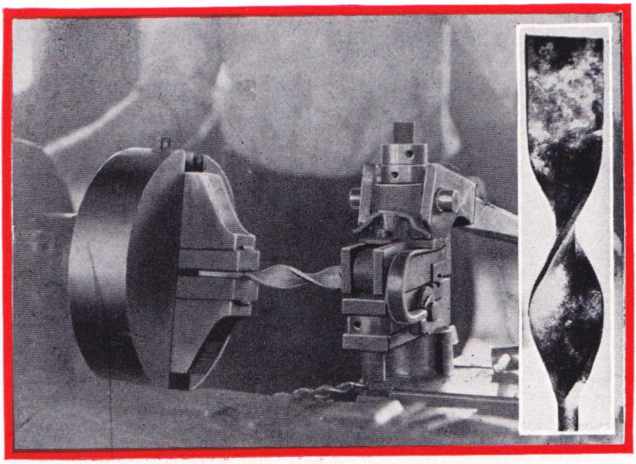
However, the general idea of a bit is that of the double twist tool—such as common augers, extension lip auger bits and most machine bits. So we now continue by showing the "twisting" operations on such tools.

The "plate" of our bit is now twisted. The tray has moved and the forging heated once more. The square of the bit is locked in a chuck and the flat tip gripped by a clamp. Then the operator moves a lever which allows the chuck to revolve slowly until the correct number of twists have been formed.

We have told briefly how the "twist" is put in. We have



Forming the "Plate"



Putting in the Twist

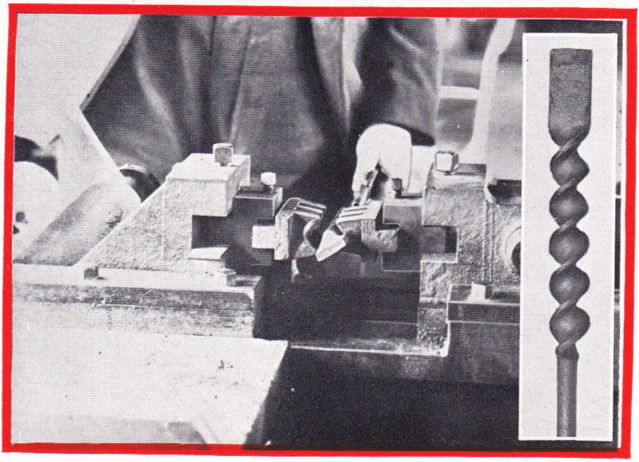
sketched the simple machine for doing it. But we have not shown how accurate this spiral must be.

A bit should be absolutely uniform in the curve of its spiral, similar parts of each spiral equal in thickness and spacing, and the twist exactly centered.

The twister must have each forging at the right heat and uniformly hot, or the bit will twist tight at the one spot and open at another, thin here or crumpled there. But how simple it looks when the operator "knows how."

Like all the other operators, he knows how long it takes to correctly heat any size bit. You see a number of forgings in his furnace, to which he adds fresh ones as he removes the hot pieces, but with absolute regularity and timing.

How do we get a true and uniform spiral by simply twisting a hot bit plate? We don't get it accurate by twisting alone. It requires another operation, as you will now see.



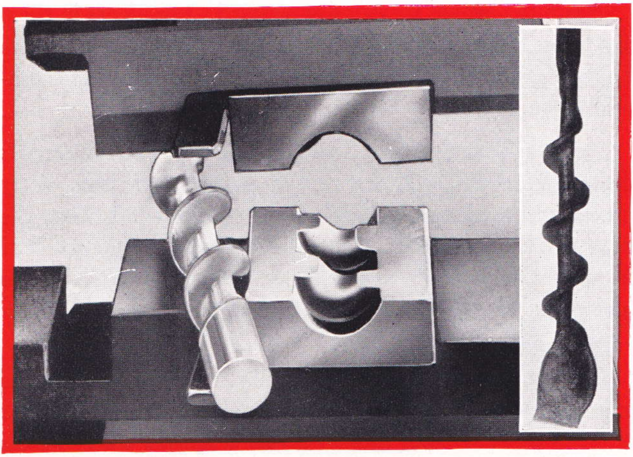
"Crimping"

"Crimping" is the bit makers' term for accurately finishing and centering the spiral of a bit. Even with careful twisting a bit may be "off center."

The machine for this operation might be called a "centering" machine. A Greenlee bit is absolutely true in twist and center, because we are exact in this operation. So after it is twisted, the bit goes to this crimping machine fitted with two peculiarly shaped dies. They have a row of round faced double teeth. The teeth incline oppositely in each die.

These dies reciprocate with a short stroke while the operator turns the bit between them. The dies strike the heated bit a series of light quick blows. The result is a perfectly uniform twist centered on the axis of the bit.

In making a ship auger or solid center bit we get our twist accurate as at first forged under the hammer. Plating, twisting and crimping are not necessary on them, as one drawing operation forms their spiral.



Forging a Solid Center Bit

Let us go back a step and see how the solid center bit is forged.

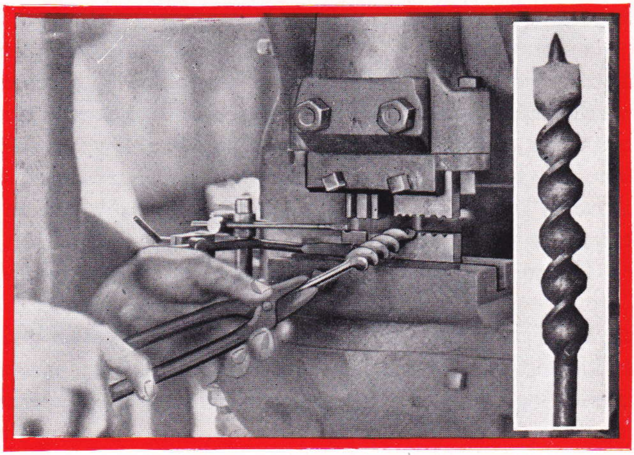
We find a hammer fitted with a pair of "toothed" dies matching each other. Each has a recess down its center which shapes the stem or solid center. Twisting around this center is a deeper recess which forms the flute. If you should take a red hot solid center bit and press it between two blocks of wood, the outline burned in each block would have the exact form of these dies.

The operator starts with a hot piece of round steel and "breaks it down" under the hammer to the rough form of the stem and the spiral flute. He then rolls or twists the bit back and forth through the hammer dies, just as the operator does in crimping a double twist tool. He finishes by carefully forming the spiral under the head of the bit and flattening the section at the end from which the screw and cutters are afterwards formed.

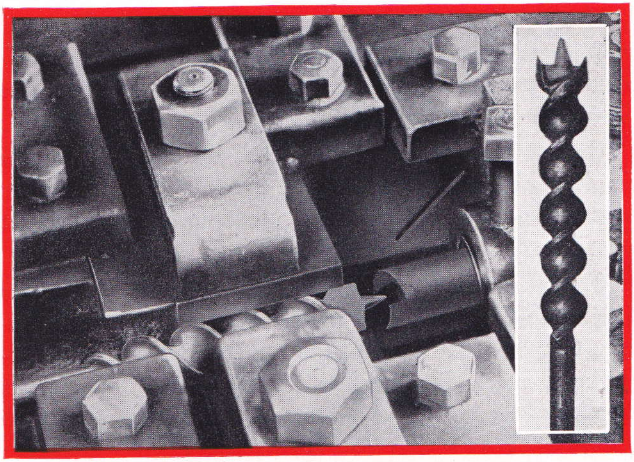
Again the loaded trays move forward. The pieces in them have now assumed the rough appearance of bits. We have shanked them, plated them, twisted them, crimped and centered them.

Now to "point" them. This machine clips out the corners of the original end section as left in plating, and then neatly rounds and tapers the center where we afterwards form the screw point. The picture shows the machine and the result of the operation. The operator heated the steel again before "pointing," and the little piece which falls into the pan below is called "bitmakers breeches."

Our bit becomes more of a reality. Every operator has done his work carefully and then examined it. He cannot afford to slight it. Our first shop rule is correct work, second to that is speed.



"Pointing"



Forming the Head

The next operation is hard to picture. The head of the bit must be formed and the "spurs" added. The machine is a special "upsetting" machine. The bit goes in head foremost, gripped between powerful jaws. A die comes forward with a shock and forms the head.

Our camera stood on its head to look down on this low massive machine. You see the two clamp holders which automatically seize the bit, and at right angles with them the die that forms the head at one stroke.

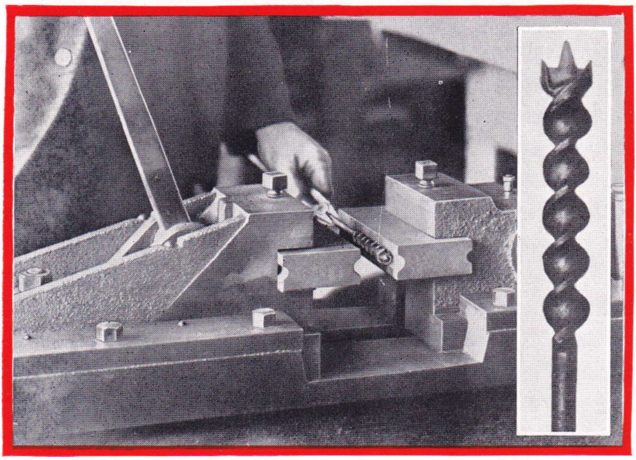
The bit was heated again for heading, but this time only its head. Consider the number of "heats" our bit has passed through. You might think that heating and reheating, hammering and rehammering injures the quality of the steel. It does not if the heating is properly handled. This is another thing our operators are trained in—heating steel, and constantly checking the temperature of the furnaces to maintain the degree suitable for each operation.

Repeated heating and hammering refines steel. The steel maker in selling his finer grades says, "it is hammered stock." Scientific heating and thorough hammering developes the highest qualities in a good steel.

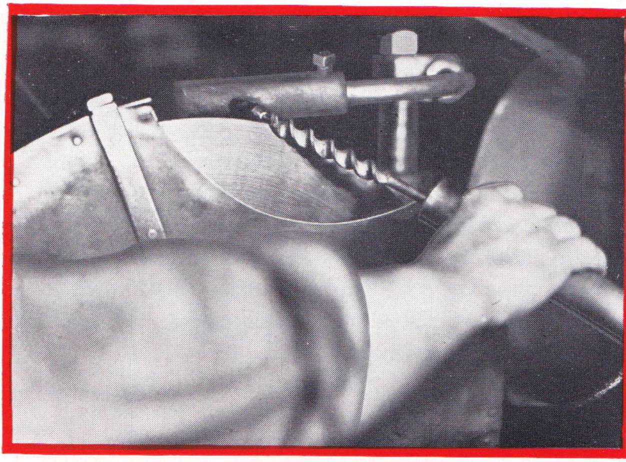
Our bit is now nearly through the forge shop. It seems a simple forging and yet many men and much skill and labor have been needed to produce it. But before it moves again it must be straight. We again heat it for this operation.

The bit is placed in the straightening machine. This, as the photo shows, consists of two hollowed-out dies which conform to the outside edges of the bit, each bit, of course, requiring corresponding size dies. A movement of a lever sets the dies in motion, and at the same time by rolling the bit all unevenness in twist and shaft is removed.

This is a simple operation in view of the fact that nothing radical in form takes place, yet it practically lays the founda-



Straightening



Cutting Out the Throat on Buzz Wheel

tion for the subsequent machining operations which must have a straight and true line to work from—a straight bit from point to point.

The last operation in the forge plant is what we call cutting out the throat on a buzz wheel. Its size is about the same as that of a bicycle wheel and it has the same likeness as that of a thin emery wheel though made of solid steel. When set in motion the wheel attains a terrific rate of speed. The operator stuffs cotton in his ears because of the deafening roar. There is an isinglass shield fastened on the machine through which he watches his work. This acts as a protection to his eyes from the flying sparks and particles.

The operator places the point of the bit in a holder situated on the opposite side of the wheel. He brings the twist over the fast turning, circular blade of steel. Then bearing down on the shank of the bit, which also fits into a holder made to

fit his hand, the wheel grooves the bit and most surplus stock is removed.

Our bit is now ready for machining, which operations make the bulk of our next chapter. But before it can be machined it goes through an annealing process. Auger bits are annealed on the head only, and machine bits at both ends, but neither at the middle. This process consists of slowly reheating the bit and allowing it to cool very slowly. During this procedure the steel has been softened and now the tool can be readily machined and is delivered to the machining department in a wooden tray.

The Finishing

IN THE preceding chapter we have followed the making of our bit from a crude piece of steel to its appearance as shown at the bottom of this page. It has been formed, headed, and made straight. It has been heated eight times and has been handled over and over again. Now in its wooden tray it will travel on and on, becoming more and more a tool of utility, and finally ending up as a beautiful piece of merchandise ready for duty.

Probably you have wondered why the change from steel to wooden trays. In the forge shop a steel tray is the more practical because it will not burn from contact with the red hot bits as they come from the furnace. In the machining department a bit calls for careful handling. Therefore, wooden trays are employed as the heads of the bits in coming in contact with the wood side of the tray will not become damaged as they would in one of steel.

From now on the manufacturing cost of our bit will be greater than it was in the forging stage. Because of the peculiar shape of a bit's twist, standard machine tools cannot be used and automatic machinery has not been developed. It has eluded man's inventive genius, and so he has had to be content in shaping a bit's destiny by special machinery and a great deal of it by hand. And manufacturing by hand is an expensive procedure in this highly mechanical age.

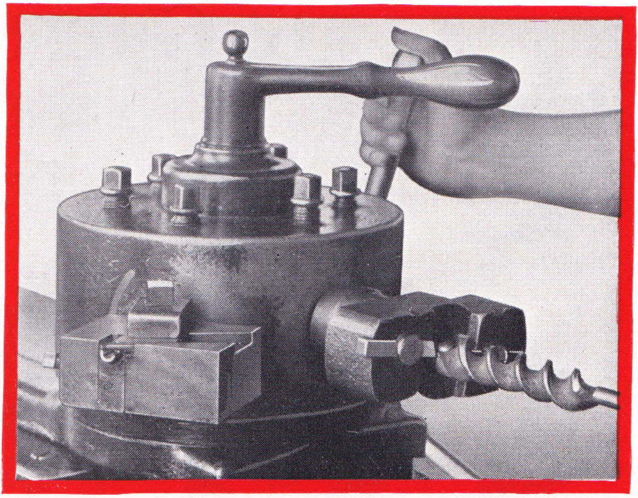
Bit Ready for Machining Operations

As we go along you cannot help but be impressed with each operation as it unfolds before us. Of course the forging operations were impressive but it seems that in the manufacture of any article the rough operations do not fascinate as much as do the ones that gradually bring it closer to a finished article.

You'll follow with interest each step as the workmen hand file the different parts of the head—you'll see how the size is placed on the shank—you'll be amazed at the operation that produces the screw point—in fact, each operation has its significance.

The first and second machining operations are done on the same lathe which has been rebuilt for the purpose. The photo shows two tools mounted on what is called the tail stock spindle. The tool at the left performs the first operation, that of taper turning the point. The shank of the bit is held in place by a revolving headstock and the point is advanced to the cutter. The result is a correctly shaped and uniform point. The operator has at his command cutters of all sizes, as the size of the point varies according to the size of the bit, but the dimensions of the point are the same for each bit of one size.

After the foregoing operation is completed the headstock chuck retreats. Then by the movement of a hand lever the tailstock spindle revolves, thereby bringing the tool-box at the right into position to receive the head of the bit for the second machining operation. The head advances and the "sizing" takes place. The photograph shows this plainly. Sizing means turning the head to the size of the bit, that is, if the tool is a 5⁄16-inch bit, the head will be turned to that size.



Taper-Turning Point and Sizing Head

After Taper-Turning and Sizing

During this operation the point is used as the center and is held in place by a springlike mechanism. Instead of there being only one cutter in the tool-box there are two, one opposite the other, which insures the head being machined concentric with the point.

In order for a bit to bore freely, the edge of the twist below the head must be slightly smaller than the size of the bit—the twist must not be larger than the size of the head. Otherwise the bit, while boring, would have a tendency to bind.

The photograph on page 26 shows the machine used for this operation and being really quite simple is practically self explanatory. Our bit is held on a revolving center using the point on one end and the shank on the other. When the bit comes in contact with the fast revolving grinding wheel, the

Giving You *an Idea* of GREENLE

And the
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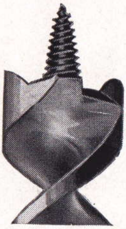
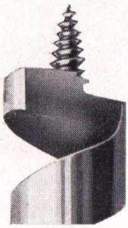
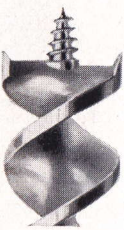


Extension Lip



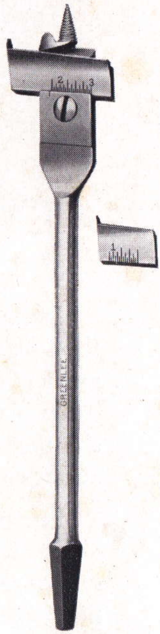
Ship Auger



Double Spur

No. 12

No. 31



No. 4

No. 12—Extension Lip Auger Bit. The bit about which this story is written. It is a smooth boring tool, and is used extensively in exacting pattern and cabinet work.

No. 31—Electrician's Auger Bit. Designed especially for Electricians' use, and is known as the fastest boring bit on the market.

No. 4—Expansive Bit.
in a variety of sizes.
wide, open throat allo
ance of chips.

No. 25—Unispur Auger
this bit has only one sp
Its outstanding featur
through cleanly.

of the Various Styles
E Auger Bits

Different
f Heads

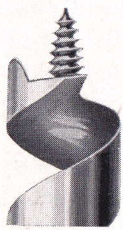
No. 25

No. 28

No. 22


Solid Center


Unispur

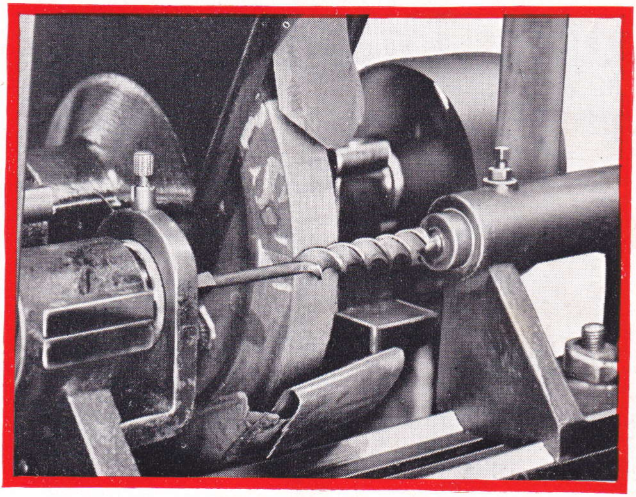

Single Twist

A bit that will bore holes
Its improved head has a
wing free and easy clear-

Bit. As its name denotes,
our and one cutting edge.
is its easy ability to bore

No. 28—Single Twist Auger Bit. A properly designed tool, and one which is well liked because of its smooth and easy boring.

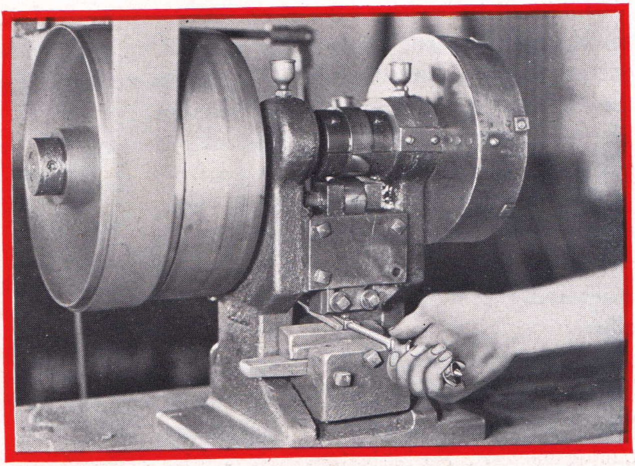
No. 22—Solid Center Auger Bit. Suitable for ordinary requirements. The center stem gives it added stiffness and the single twist provides excellent clearance of chips. Page 15 shows how this type is forged.



Grinding Edge of Twist

table holding the bit slides back and forth causing a uniform grinding of the twist the entire length below the head.

To the right we have our bit after the edge of its twist has been ground. The figure eleven on its square denotes that it has gone one step farther, which is stamping on the size. The figure is the size of the bit and means that it is $\frac{11}{16}$-inch in diameter. To those who have used or have had anything to do with an auger bit, this method of designating the size is clear. But to those who are not as familiar, suffice to say that on bits the sizes are spoken of in sixteenths, and that the number of sixteenths is stamped on the square. The whole fraction, $\frac{11}{16}$, is not shown.



Stamping on Size

The machine used for this purpose is a power driven stamper. The correct stamp is selected and inserted in what might be called the hammer. The base holds a small iron frame shaped to hold the square of our bit. The square is placed in this holder and the hammer, driven down by a cam shaft arrangement, stamps the size on the bit. Because of the round shank on machine bits, stamping the size on them is done by hand.

A part of our story will now be devoted to "fitting" the head and throat. These are important steps in the finishing of a bit, and, due to the complex nature of the head and throat, four operations are required to put the bit in shape for the hand filing operations that follow.

The first one is called facing and consists of squaring up the cutting edges of the bit. This particular operation is a

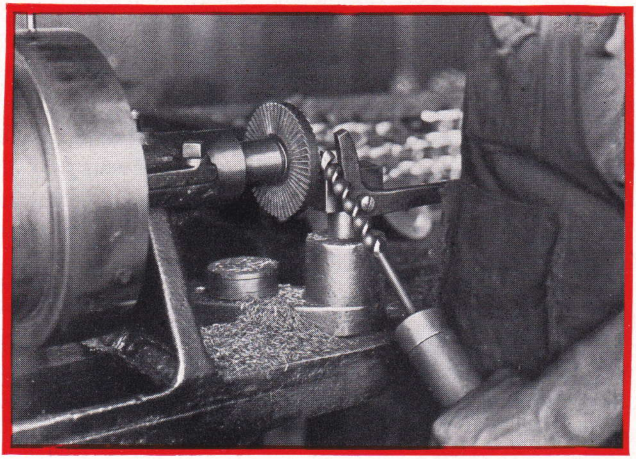
little difficult to conceive. So, along with the picture of the machine in operation, we show two views of the head. The one at the top shows the presence of surplus stock, making the two cutters apparently unrecognizable. The bottom sketch is the same head after it has been faced.

Before Facing

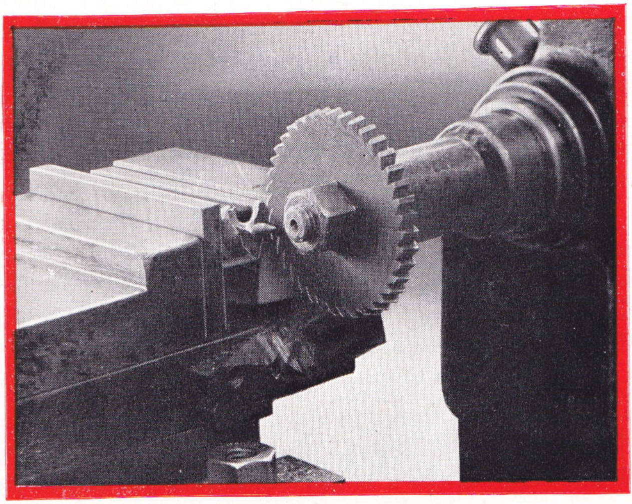
Note how prominent the cutters are now, and that they are square and parallel with each other. In short, facing squares up the cutting edges and makes them on a level with each other.

After Facing

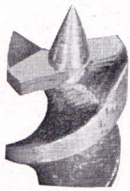
The next operation is called "topping" and is one of the most important steps in governing the cutting qualities of our bit. It is done on a milling machine. The bit is clamped in position



"Facing" or Squaring Up Cutting Edges



"Topping"



After Topping

and advanced to a cutter which has slightly angular teeth, each size bit requiring a corresponding size cutter.

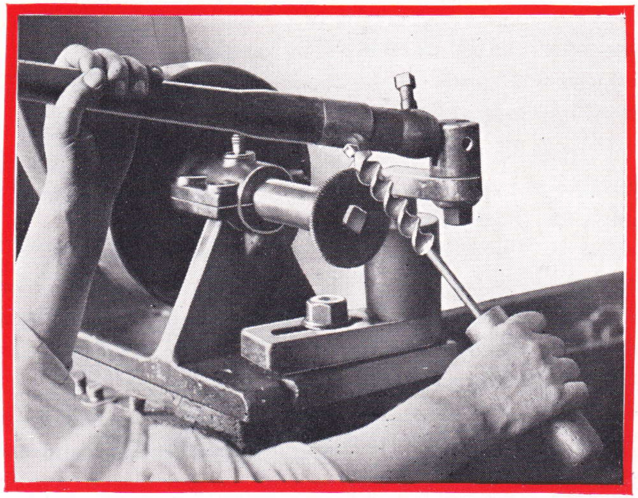
This milling operation cuts out the stock between the spur and the point, and it is the angle of the resulting slope that must be watched. This angle must be a certain amount so that the cutter will readily pick up the chip and start it on its upward journey. If the angle is not the proper pitch then the head will have a tendency to "ride" the wood and thus require excessive power to drive the bit.

This topping operation has also formed the extension lip. As the cutter milled the slope between the spur and the point, it also did away with part of the spur and left our bit with its extension lip.

The topping and facing operations have left stock at the base of the point having the shape of a diamond. This surplus must be removed next. The point is pushed in a hollow cutter, just as you would place your pencil in a sharpener, and the power driven miller cuts away the diamond, leaving a clean base around the point.

During these fitting operations we have actually been removing stock in order that we might arrive at the definite features of the head including the point. But we have not done anything about removing the surplus stock in the throat. We will do that now.

The throat, as our sketch on page five shows, is that part of the hollow just back of the cutting edges which starts the chips up the twist. The throat must have plenty of room so that the chips can leave unhindered and not clog in passage, usually termed as choking.



Removing Excess Stock from Throat

As the photo shows, the shank of the bit is inserted in a holder and the point is held by a lever. Rotating the bit with his right hand, the operator bears down on the lever and the surplus stock is removed. The shop term for this operation is "chunking."

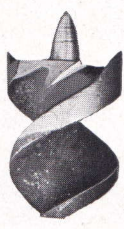
In spite of these four fitting operations we have not as yet obtained a clean cut head. This must be done by the forementioned hand filing—the spurs, cutting edges and throat thereby being placed in condition which gives us practically a sharp bit. In the bit shop this is spoken of as "finish-fitting the head."

Although these appear as simple operations it takes operators with years of experience to do them correctly, especially the more important ones. A filer when first starting out does the simple filing, and then as he gains experience he is entrusted with filing of greater importance.

Our bit is clamped in a vise. The operator has a variety of files for the different operations. First he files the face of the cutters. These are the cutting edges which were obtained by the facing operation. During the chunking of the throat the cutters were naturally brought to a finer edge but were left in a roughened condition. And it is this that is remedied by face filing. The cutters again become even and square.

The second filing operation rounds and uniformly shapes the spurs. This also includes filing the inside of the spurs which gives them a knife like edge. Both spurs must be the same height as they outline the hole in advance of the cutter.

You, no doubt, remember the topping operation detailed on page twenty-nine. The resulting tops, because of their being milled by a cutter, were left with a rough surface. Smooth finishing these is also done by hand filing. This makes the cutters sharper at the same time.



Point After Under-Cutting

Now we come to what is called undercutting the point at the base. In doing this a lead is furnished for the thread, that is, when threading the point the bottom thread can be run into the cutter. With a file a groove is cut at the base under the cutter where it meets the base of the point. Since this is a little difficult to understand, a sketch of the undercut point is shown on the preceding page.

Filing the bottom of the cutters is the last of the filing operations for the time being. This is shown in the large picture below. During this procedure the cutters are rough

Filing the Bottom of Cutting Edges

sharpened and the roughness in the throat caused by chunking is partly eliminated.

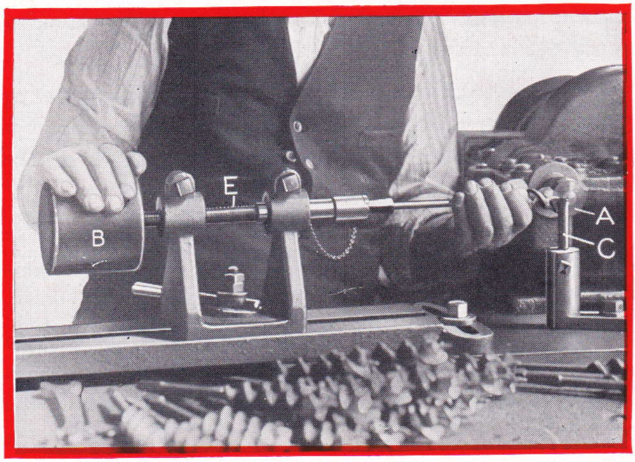
Finally we come to what is considered the most interesting operation in the making of an auger bit. It is threading the point, which will make that part known hereafter as the screwpoint.

Because of its tapering shape it cannot be handled like the threading of an ordinary bolt by using a die-head, but is done on a specially built machine shown on the next page.

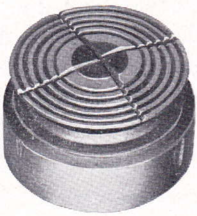
Although this operation is interesting it is not easy to make plain by the use of words even with the help of pictures. So we will acquaint ourselves with the various parts of the machine and their functions, and then go through with the threading of our bit from beginning to end.

Figure A is the ring grooved disc that cuts the thread on the point. The sketch of it gives a plain idea of its ring grooved face—the rings cut through by lines running from the center to the edge of the disc, forming nitches in the ring grooves which act as cutters. In operation this disc travels at a speed of approximately 14,000 R. P. M. For each pitch of the thread, that is the variations from the coarse to a fine thread, there is a corresponding size disc. The pitch of the grooved rings of the disc must correspond to the pitch of the screw point.

Figure C is a support for the point of our bit. Figure E is a threaded shaft which also acts as the holder for the shank of the bit. The threads on E must be of the same pitch as the ring grooves in disc A. So for each pitch of our screw point there is also a size E to correspond. The thread on E also furnishes the back and forth motion that the shaft and bit attain as the hand and forearm are drawn in a sawing fashion across spool B.



Threading the Point



Disc "A"

We already have our bit in the holder and the point supported by C. Now the thread will be put on. The operator sees that the lead which was undercut a little while back by filing is at the edge of the disc. He does this so that the thread will run into the cutter, the thread and the cutter becoming one cutting unit. Pressing the point against the disc starts the cutting process, and then rotating spool B back and forth, which causes the point to move back and forth, the point is threaded. If screw E was just a plain shaft, then rotating spool B back and forth would not move the bit back and forth, and only rings on the point would be the result and not a spiral thread.

Of course there may be a little curl of steel left at the

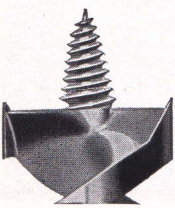
base which was cut from the thread but this will be removed by filing later on in our story.

Yes, threading the screw point requires an experienced operator. The man youngest in experience has been at it for twenty-two years while the oldest in experience started when fourteen years old, and is still at it at the age of seventy. When he first started they formed the screwpoint by hand filing.

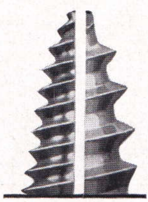
Our bit looks like the real thing now since it has received its screw point—the part that pulls the bit into the wood as we bore.

Bits have, as before mentioned, different pitch screw points. A coarse screw point will bore faster and is the type best suited for use in soft woods. The finer thread will bore slower and naturally is ideal for hard woods, since a smaller chip will be cut by the cutting edge. And should the screw point be coarse, a large chip would be the result, which you can see would tend to make boring with such a type in hard wood an act that would require excessive driving power.

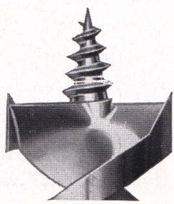
But as the photographs show, a No. 12 single screw is the same in pitch as a No. 12 double screw and will bore at identically the same rate of speed. A single screw has only one thread or spiral from the tip of the point, while the double screw has two threads starting from opposite sides at the tip and running parallel down to the base.



Double Screw



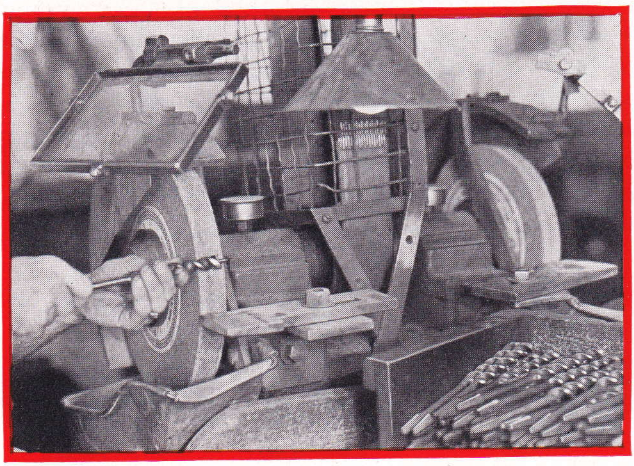
Comparison



Single Screw

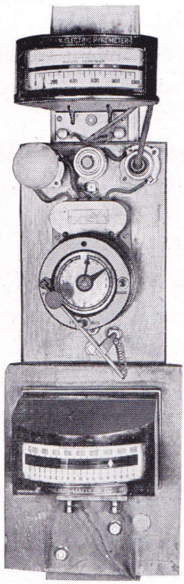
Our bit will now be taken to the hardening room. On its way down it stops at a grinding machine provided with two emery wheels. The wheel to the left, shown in use, is grinding clearance back of the head. You may have noticed when grinding the edge of the twist its entire length, excepting the head, that there was left a little step, so to speak, from the head to the twist. That is what is being remedied now—making that step a gradual, almost unnoticeable slope. This also makes the head's circumference below the spurs a trifle smaller than the circle outlined by the tip of the spurs. Because of this the tips of the spurs will cut a trifle larger than the section beneath the spurs, making boring easier.

Or in other words, the purpose of grinding clearance back of head compares with "setting" the teeth in a saw. The saw would bind if the teeth were not set so that they will make a cut a trifle wider than the saw itself.



Grinding Clearance Back of Head

One Corner of Heat Treating Room



The wheel to the right grinds off the "shoulders" on the twist. The shoulders are what might be called the corners of the twist as it starts twisting from the shank. This grinding makes those corners less prominent.

The journey through the hardening room gives the bit its inward quality. Here it is hardened and tempered so that its cutting parts will hold their edges, and it also strengthens the bit so that it will withstand the severest kind of boring.

The bits are placed in a rack and suspended above the lead pot, allowing only the heads to be immersed in the molten lead. This is shown in the

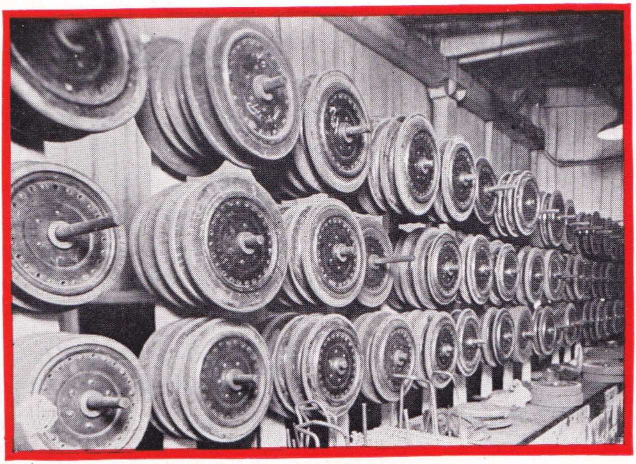
picture in the right foreground. The dial of the lower pyrometer, shown in the smaller photo, indicates the temperature of the lead. The clock-like apparatus in the center is the timer. When the bits have taken up the required time for proper heating, a clicking sound and the flashing on of the light indicates that they should be taken out. They are then quenched in oil which hardens them.

Because of the pyrometers and timer, nothing is left to chance. Every bit is assured of a uniform temperature, each temperature being predetermined according to the nature of steel and kind of bit. After quenching, the bits are placed in a basket and are again immersed in oil only this time it is tempering oil. In this they are slowly heated. The pyrometer at the top indicates the heat of this oil.

Tempering toughens the bits, otherwise they would be too brittle causing breakage of screw points and spurs. After they have been allowed to remain in this tempering oil for a predetermined length of time they are removed and dipped in hot water. They are then taken to the polishing room.

At last we are on the home stretch—polishing our bit and getting it into perfect condition for the consumer. And these are the operations that are the costliest of all in the making of an auger bit. It is the large amount of handling that makes them so. In fact the polishing operations amount to approximately 30 to 40% of the total cost of manufacture. It is only by turning out bits by the thousand that it is possible to buy them for a few cents a piece.

The photograph on the next page gives an idea of the great variety of wheels that are used. The wheels have leather rims which are dressed with glue and emery. The rim is immersed and revolved in glue giving it an even coating. After the glue has dried, the rim is again covered with glue in the same way, and is then rolled in a trough partly filled with



Portion of Polishing Wheel Rack

emery, the glue-coated leather face becoming covered with an even distribution of emery. It is then allowed to dry after which it is ready for use.

The emery is of different grades. A coarse emery is used for the rough polishing and a finer grade for the finer polishing.

The first polishing step consists of rubber-wheeling the hollow which removes all excessive roughness. The wheel used is of thin construction, and is made of a rubber and emery composition throughout.

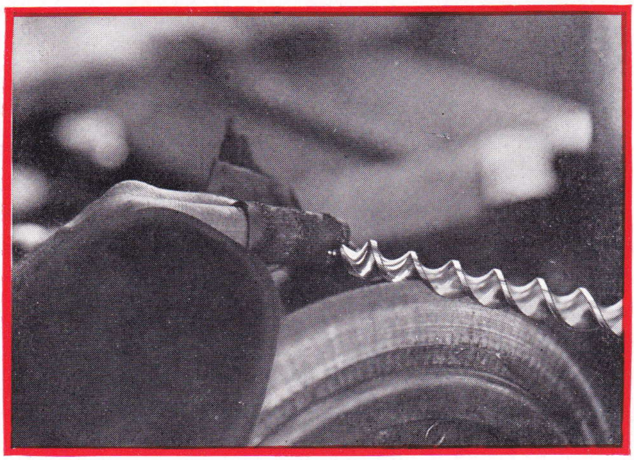
In the next operation a flat surfaced wheel is used since we are rough polishing the shank and the edge of the twist. This wheel, as are all the wheels used from now on, is coated with glue and emery as previously explained.

Our bit begins to appear a little brighter. As we advance, a finer grade of emery is used for each step. The photograph

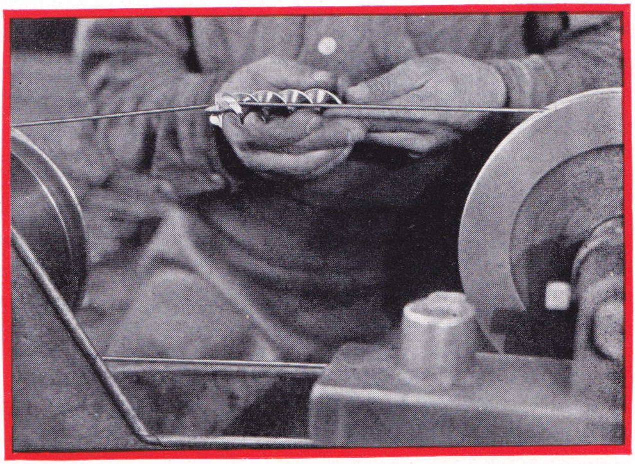
at the bottom of this page illustrates smoothing the hollow. In the same manner, the edge of the twist and shank are smoothened, but on a flat surfaced wheel.

Since it is impossible to polish the screw point on a wheel, the bit is placed in an ordinary hand brace. After covering the screw point with emery and oil it is screwed into a plank of hard maple, and is then withdrawn. This is usually done twice. Besides leaving the point with a polished surface, this operation also determines if the screw point will pull the bit into the wood.

Our bit has received its preliminary polishing, but before it is finish polished the spurs and cutting edges are sharp filed ready for use. These filing operations amount to about the same thing as the filing in the fitting department, explained on pages thirty-one and thirty-two, the only difference



Polishing the Hollow



Strapping the Throat

being that this time they are made absolutely sharp. Also the little curl of steel left when threading the screw point is removed.

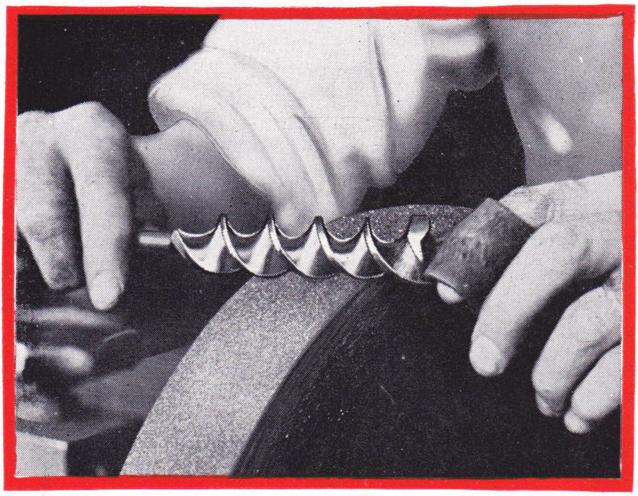
The next operation consists of strapping the throat. The sketch shows how this is done. The strap is a strip of heavy canvas coated with emery and glue. It is like a belt and runs on two pulleys. A wheel could not be used in polishing the throat as it is not pliable like the strap and therefore would ruin the cutting edges of the bit. There are really two operations in strapping since two grades of emery are used, one for the rough polishing, and the finer emery, which is oiled, completes the finish polishing.

This oil finishing is next done in the hollow, using a wheel as on former hollow polishings. The shank and edge of the twist are dealt with in the same manner. Oil polishing gives a fine, smooth surface. You may have wondered how oiling

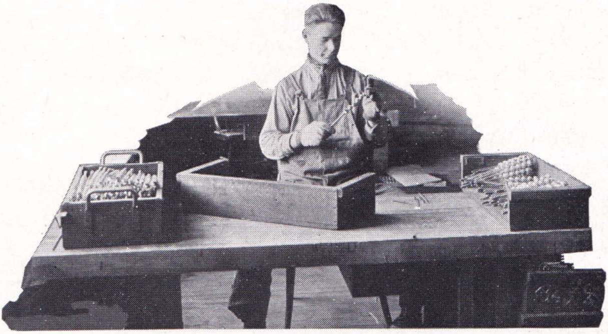
the emery wheel is accomplished. The oil comes in the form of a cake. It is nothing more than fine emery powder soaked in oil and then allowed to harden. The cake is held on the fast revolving wheel, and in that way the wheel becomes moistened with oil.

After these oiling operations comes the final polishing. The dressing on these wheels is of a very fine emery, so fine that it looks like powder. Great care is exercised during this operation in order to get the high color that makes our bit a beautiful piece of merchandise. Of course this powder-emery polishing is done in the hollow, on the shank and the edge of the twist.

The last manufacturing operation has been completed and our bit is finished. From a rough piece of steel we have watched it. We have seen the workmen do their operations,



Polishing Edge of Twist



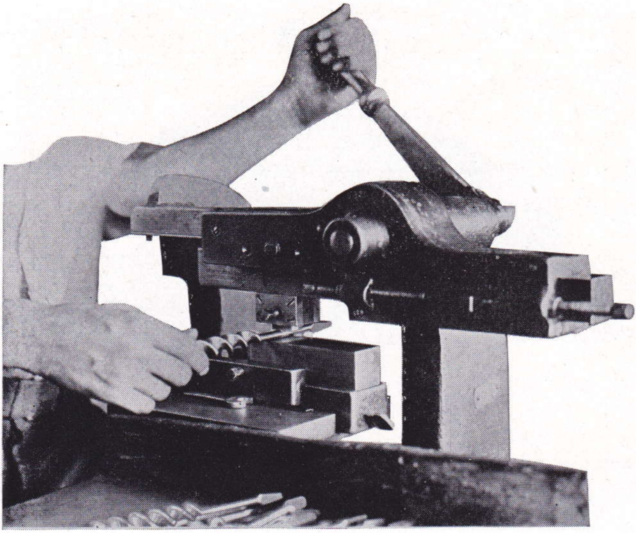
Inspection

each one advancing the bit a step farther in its manufacture. And from the first to the last, careful and skilled workmanship has been the outstanding characteristic of each. With many of them, bit making is their life work, in some instances father and son working side by side.

But before our bit can leave the plant it must go through a thorough inspection.

The inspector has been taught what constitutes a perfect bit. He knows that there must not be any black spots or holes on it. He can tell when the spurs, cutting edges, and screw points are properly formed. Should he find any defects in a bit he throws it aside and does not allow it to travel on with the bits that are found to be perfect. Or should the defect be only a slight crookedness in the bit's length, he straightens out the high spots by tapping gently with a lead hammer.

Our bit must have a trade name. That is what is taking place in the picture on the next page. The operator steps on a treadle which raises the shank-block pressing the shank of



Stamping on Trade Name

the bit against the die. Pulling the top lever with the left hand slides the die forward, thus virtually rolling on the trade-name.

Our bit is next wrapped in a sheet of protective paper and packed in a box along with five other bits of its kind. It is then placed in stock.

The room pictured on the next page is a shipping and stock room combined. The large bins that appear as rows of shelves to the left hold the surplus stock of auger bits and machine bits. The white numbers painted on the bins mean that a particular type of bit will be found in the bin so marked. No. 12 happens to be the number of our bit, and its bin is located toward the rear of the picture.

Stock Room

At the time this story is written there are 678,307 bits in stock—a plentiful supply to meet all standard requirements. And in the process of manufacture there are 640,068.

Besides the plant pictured on page two, Greenlee Tool Co. also have a plant located in Jackson, Ohio. This factory is devoted exclusively to the manufacture of solid center auger bits. The number in process of manufacture there is included in the number stated in the preceding paragraph.

These facts point out clearly that the manufacture of Greenlee auger bits constitutes a very large industry.

Yes, we have gone through the operations in The Making of An Auger Bit. At the beginning we were informed that there were about 45 of them. The statement may have seemed a little bit strong at the time, but certainly it does not seem that way now. We have learned that though an auger

bit may appear as an ordinary article, its manufacture is quite a complicated affair, and one that is highly interesting all the way through.